Name ______________________________________ Date ______________

Partner______________________________________

**Ohmic and Non-Ohmic Resistors: E&M Lab #5**

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**Objective:** to investigate the electrical resistance properties of various materials.

**Equipment:**

**Physical sketch:**

**Electrical sketch (circuit):**

**Definitions:** Ohm's Law:

**Background:** In the 1790s people were able to make reliable voltage differences. When they connected the different voltages with a wire, they found that electrical current flowed through the wire. However, it wasn't until the 1820s that a reliable current meter was developed. Then people found that in many cases the input value of $\Delta V$ (voltage difference, emf) drove the output value of I (current) linearly. However, in some cases it was not a linear relationship, and this was puzzling.

**Procedure:**
The input value for each object is the applied voltage. The output value is the electrical current which flows through the object as a result of the voltage.

Each object will have a different resistance to the flow of current, and the resistance may sometimes be a function of the applied voltage. You should be thinking of what is happening at an atomic level to make this happen.

Make a data table to record the applied voltage and the resulting current for each object.

**CAUTION: Make all connections before turning on the power supply.**
**CAUTION: Do not exceed a voltage of 30 volts.**
**CAUTION: Do not exceed a current of 500 milliamperes.**

**1. First Object: A Carbon resistor**

In your data table record the voltage orientation of the ends of the resistor, because you will eventually repeat the measurements with the voltage reversed.

a) Take your first reading with a 1.5 volt D battery, then reverse its leads to take the -1.5 volt reading.
b) Connect the power supply and take a number of readings of voltage and current. Use 1, 3, 5, 10, 15, 20 volts etc. Stop before you exceed the voltage or current limits.

Turn the power supply to zero, turn it off, then reverse the leads on the resistor. Turn the power back on and take a number of readings of voltage and current at the same values as before. Record these voltages as negative. Is the current negative also?

c) Make a plot of current (I) vs. voltage (V). Recall that the voltage is the input, so is plotted on the x-axis. The output of the experiment is the current, so it goes on the y-axis.

**2. Second Component: An Incandescent lamp**

In your data table record the voltage orientation of the electrical ends of the lamp, take readings of current flow every 5 volts or so, then reverse the leads and take the negative voltage readings.

**3. Another electrical component**

Choose another component from the supply available. In your data table record the voltage orientation of the electrical ends of the component. Some of these components are semiconductors, so take readings at small voltages (.3, .5, .7, .9 volts, etc, never exceeding 500 milliamps). These components can be dangerous to your meter and cause it to blow a fuse.

Then reverse the leads and take the negative voltage readings.

**4. Yet Another electrical component**

Choose another component from the supply available. In your data table record the voltage orientation of the electrical ends of the component, take readings of current flow, then reverse the leads and take the negative voltage readings.

**Analysis:**

For each of the four resistive components make a plot of current (I) vs. voltage (V).
For every measurement pair, calculate the ratio V/I. This is the resistance (R).
For each of the four resistive elements make another plot of resistance (R) vs. voltage (V).
Fit a trendline to find the equation of I = f (V), if possible
Discuss these various versions of R

**Discussion and Conclusions:**

Which of these material objects obey Ohm's law?

Which of these material objects do NOT obey Ohm's law?
Why not (what may be happening to change the material propereties)?

**How does this topic apply to your life?**